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Note on the Sheltering Effect of Hills on Winds of Low Velocity at Waltham Cross

During the past seven years observations of wind direction have been made, twice a day, at fixed hours at Waltham Cross, in the Lea Valley, 12 miles north of London. The annual summaries of frequency, with the exception of 1928, all show a slightly lower frequency of NW. winds than is consistent with a smooth curve of frequencies. The Percentage Frequency Diagram (fig. 1), based on the seven years 1925-31, shows a slight but distinct minimum frequency of NW. winds. The vane used has an excellent exposure, and the minimum at NW. seems too slight to be due to any bias in the instrument. Accordingly I have made the following attempt at a satisfactory explanation of the apparent deficiency of NW. winds.

The map (fig. 2, slightly more than 2 miles to the inch) shows the contour of the country to the west of the station, and it appears that there are four channels, down which light winds might be deflected towards the point of observation.

A light wind approaching the station from the north-west becomes deflected and passes the station as a NNW. wind at 332°. A WNW. wind has two channels, WNW. (1) following the same channel as NW. and passing the station as a NNW. wind at 332°; WNW. (2) follows a channel further south, passing on the southern side of the low ridge (A), and passing the stations as a W. wind at about 280°. A W. wind has also two

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channels, W. (1) entering the same channel as WNW. (2), but passing to the north of ridge (A), crosses the station at 294° as a WNW. wind; W. (2) passes further south and crosses the station as a WSW. wind at 256°. WSW. winds are unobstructed, while very slight SW. winds may be deflected into the west-south-west channel by the low peak (B).

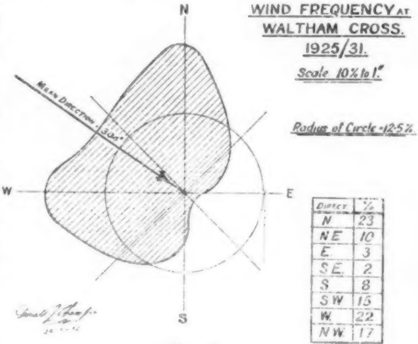


FIG. 1.

All winds from N N W., W N W., WSW., etc., are in monthly and annual summaries, equally divided between the adjacent points on either side. Allowing two points for each observation of direction, NNE. becomes N.1, NE.1; N. becomes N.2; NNW. becomes N.1, NW.1; NW. deflected becomes N.1, NW.1; WNW. has two channels and WNW. (1) becomes N.0·5, NW.0·5; WNW. (2) becomes W.1; W. also has two channels and W. (1) becomes NW.0·5, W.0·5 W. (2) becomes W.0·5, SW.0·5; WSW. unobstructed becomes W.1, SW1; SW. perhaps slightly deflected becomes, say, W.0·5, SW.1·5; SSW. becomes SW.1, S.1.

Tabulating the results we have :—

Obs. from.	N.	NW.	W.	SW.
NNE.	1·0	—	—	—
N.	2·0	—	—	—
NNW.	1·0	1·0	—	—
NW.	1·0	1·0	—	—
WNW. (1)	0·5	0·5	—	—
WNW. (2)	—	—	1.0	—
W. (1)	—	0·5	0·5	—
W. (2)	—	—	0·5	0·5
WSW.	—	—	1·0	1·0
SW.	—	—	0·5	1·5
SSW.	—	—	—	1·0
Total ...	5·5	3·0	3·5	4·0
Apparent Error	+ 1·5	− 1·0	− 0·5	0

From this table we may assume, that with light winds N. gains 1·5 points at the expense of NW. and W., which lose 1·0 and 0·5 points respectively.

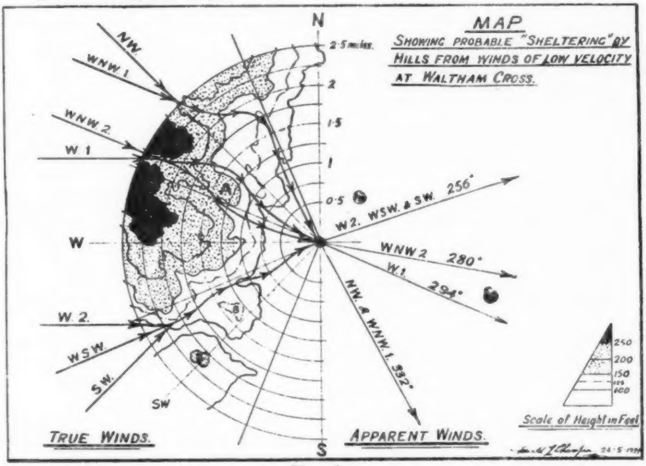


FIG. 2.

Upon considering these results, one is inclined to wonder why the hills to the east and north do not have similar effects in producing irregularities in the distribution of winds from these quarters. Accordingly I set out to find some explanation of the observed facts, and calculated values of "Sheltering Factors" for each direction of azimuth.

Let S = the factor, then $S = \frac{(H - h)}{D}$ where H = height of obstruction above M.S.L. and h = height of station above M.S.L., both values in hundreds of feet, and D = distance of obstruction from the point of observation in miles and tenths. The highest value of S. in each direction is taken as the "Sheltering Factor."

Direction.	*Factor.*	*Direction.*	*Factor.*
N.	0·12	S.	0·00
NNE.	0·04	SSW.	0·00
NE.	0·14	SW.	0·25
ENE.	0·47	WSW.	0·39
E.	0·13	W.	0·91
ESE.	0·29	WNW.	0·57
SE.	0·12	NW.	1·00
SSE.	0·24	NNW.	0·50

The results tabulated above, indicate that values above 0·5 appear to have effect in the obstruction and deflection

of light winds. Only winds between W. and NW. have a higher factor than 0·5, which makes clear the reason why winds from other directions are unaffected.

Unfortunately I have no data giving the force of the wind, only the direction being observed. This makes it difficult to estimate the minimum velocity at which winds are deflected; however, the figures obtained seem to give a reasonable explanation of the apparent deficiency of NW. winds, which is the more accentuated by the corresponding excess of N. winds.

DONALD L. CHAMPION.

Roll Cloud seen at Bournemouth

The photograph of a fine specimen of a roll cloud, which is reproduced as the frontispiece of this number of the magazine, was taken by Mr. G. C. Nickels, of Enfield, at Bournemouth at about 5 p.m. on April 30th, 1932. Mr. Nickels remarks: "The photo does not do full justice to the spectacle, as the cloud was a brilliant white and, as can be judged from the few bits of land visible, must have extended for many miles. I watched the phenomenon for about 10 to 15 minutes, when it gradually broke up, as near as I can explain, into cirro-stratus. I cannot say how long it had formed previously. The headland in the dim distance on the left is The Foreland, and on the right Canford Cliffs." Mr. Nickels is to be congratulated on securing a photograph of so good an example of roll cloud.

An examination of the charts for April 30th, 1932, shows that a stationary depression was situated off the south-west coasts of the British Isles and that a stream of returning maritime polar air was flowing from the south over France and England. The 18h. G.M.T. chart for this date shows a line of rain stretching from Worthy Down (Winchester) in a south-easterly direction to France. This rain was associated with a minor front which had developed in the current of returning maritime polar air, forming probably the boundary between air coming from the south of France and air which had come on a shorter track round the depression.

There is little doubt that the roll cloud photographed at Bournemouth was the frontal cloud of this front. It was seen to the west of Bournemouth at about 5 p.m. (16h. G.M.T.). An examination has been made of the autographic records from Meteorological Office stations in the neighbourhood. The records from Calshot show that a well-defined front passed that station at about 17h. 5m. G.M.T. The passage of the front was accompanied by a sharp fall in temperature, a rapid veer of the wind from east to south-south-east with gusts up to 39 m.p.h.,

and rain which lasted about an hour. At Boscombe Down the front passed at about 17h. 40m. G.M.T. Here there was a fall of temperature of 8°F. and rain lasting about an hour. No wind records are available from this station. The front reached Worthy Down at 17h. 55m. G.M.T. Here, too, there was about an hour's rain behind the front. At the passage of the front, temperature fell rapidly some 8° or 9°F., and the wind veered suddenly from ESE. to S. with gusts up to 38 m.p.h. The front reached South Farnborough at 19h. 15m. G.M.T., and by this time was becoming diffuse. Temperature fell less and more slowly although there was a quite sharp fall of 4°F. The wind was practically calm and there was no gust, while no rain occurred until an hour after the passage of the front.

From the time at which the roll cloud was seen at Bournemouth and the times of passage of the front at Calshot, Boscombe Down, Worthy Down and South Farnborough, it is clear that the front ran in a north-west—south-east direction and moved in a north-easterly direction.

W. C. Kaye.

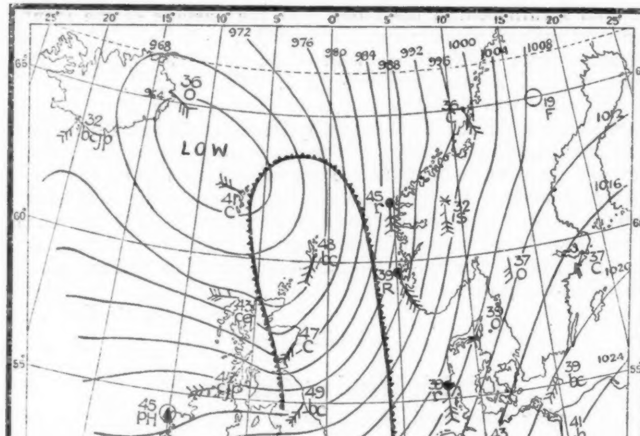
A High Wind at Bell Rock

The following note describes the main features of the synoptic situation for north-west Europe on January 13th of this year, for which day the anemogram from the Bell Rock Lighthouse is reproduced here. The lighthouse is situated on an isolated rock about 15 miles east of the entrance to the Firth of Tay, and the anemometer head is 126 feet above mean sea level. For further details of the location reference should be made to this magazine for September, 1929, p. 177.

On the evening of January 12th, an intense depression occupying the north-east Atlantic was centred south of Iceland. This moved north-eastwards during the night, and by mid-day on January 13th the centre was situated just north of Thorshavn. Pressure on the continent was high, so that north-west Europe was under the influence of a strong southerly to south-westerly gradient, as had been the case also for the previous few days. The air passing over the British Isles had followed a long though comparatively rapid track across the Atlantic; air masses of varying stability alternated with one another, according as the air was drawn from higher or lower latitudes on the western Atlantic, so giving rise to a series of fronts or occlusions moving in a north-easterly direction across the British Isles. The temperature was abnormally high for the time of year, even in the less stable types of air.

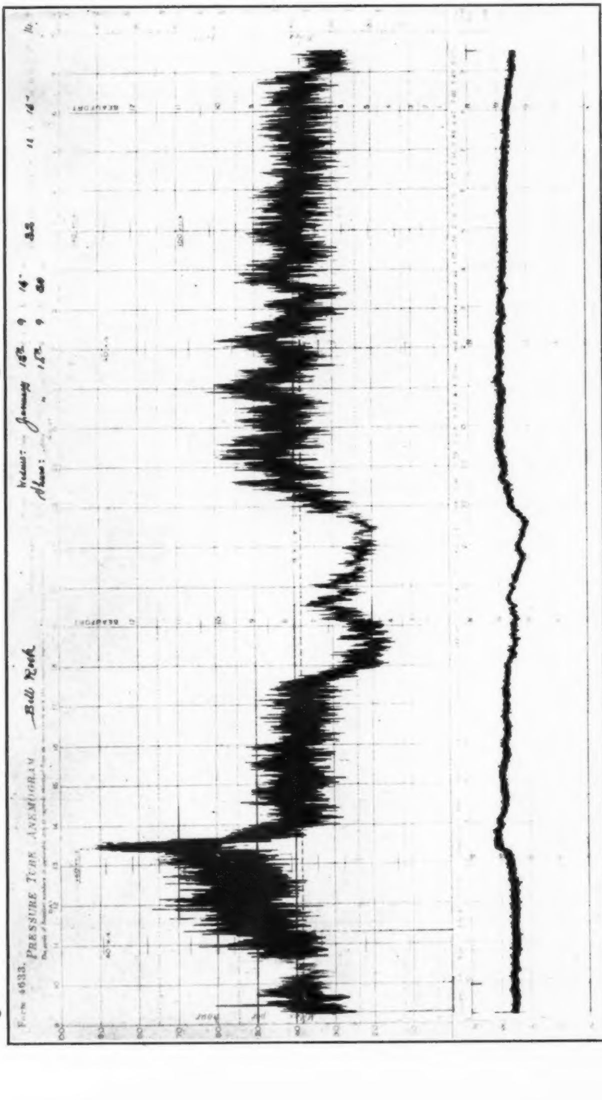
At 7h., January 13th, a narrow warm sector lay over England, from which an occlusion extended northwards through

Scotland and then curled backwards towards western Ireland. By 13h. the main part of this occlusion was approaching the coast of Norway, while the bent-back portion lay over Scotland, passing between Inchkeith and Leuchars, at which station the wind veered from SW. to W. at 13h. 5m. The gradient wind



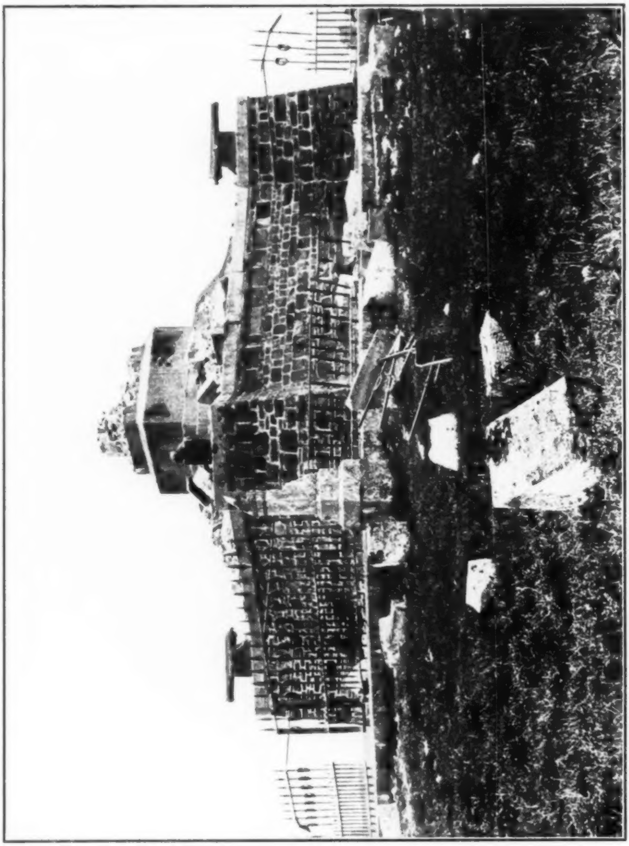
WARM FRONT COLD FRONT OCCLUSION

speed at this time in the neighbourhood of these two stations was about 90 m.p.h., so that the remarkably high speeds recorded at Bell Rock betwen 13h. 20m. and 13h. 35m., viz., an average speed of about 75 m.p.h., and gusts up to 95 m.p.h., and the accompanying veer of wind from WSW. to W. undoubtedly occurred with the passage of the occlusion. At the same time,



ANEMOGRAM, BELL ROCK, TORQUAY, JANUARY 13TH-14TH, 1932.

facing p. 135



(*S. R. Dark, Photographer, Bideford.*)
GRANITE OBELISK SHATTERED BY LIGHTNING (*see* p. 136).

as appears from neighbouring stations, the temperature fell a few degrees and pressure began to rise with unusual rapidity, the increase between 13h. and 16h. amounting to 12.2mb. at Leuchars and 10.6mb. at Aberdeen.

Meanwhile the depression continued its north-eastward motion, and by 7h. the next morning there was a series of centres extending from south-west to north-east of Iceland. The lowest pressure for this region recorded on the charts in this period was 960.3mb. at Thorshavn at 10h., January 13th, while it may also be noted that a SW'W. wind of Beaufort force 11 (about 70 m.p.h.) was observed at Lerwick at 18h. of the same day. The average speed of 75 m.p.h. recorded at Bell Rock is equivalent to Beaufort force 10, when allowance is made for the fact that this anemometer is about 90 feet above the standard height.

A. F. CROSSLEY.

Royal Meteorological Society

The last meeting of this Society for the present session was held on Wednesday, June 15th, in the Society's Rooms at 49, Cromwell Road, South Kensington, Prof. S. Chapman, F.R.S., President, in the Chair.

Prof. G. I. Taylor, F.R.S.—The resonance theory of semidiurnal atmospheric oscillations. (*Memoirs, Vol.* 4, *No.* 35.)

The theory that the semidiurnal oscillations in the atmosphere are due chiefly to resonance requires that a free period very close to 12 hours shall exist. Tidal theory shows that the corresponding speed of a free wave is 910 ft. per sec., but direct calculation, and also observations of the Krakatoa air wave agree in giving the velocity of free gravity waves as about 1,050 ft. per sec. It has been suggested that this discrepancy might be explained if rapid pressure changes take place adiabatically, while semidiurnal changes are more nearly isothermal. In the present paper this theory is shown to be untenable, because the radiation or conduction necessary to produce any appreciable difference in the speed of the wave from that appropriate to adiabatic changes would give rise to so much damping that amplification by resonance to the desired extent would be impossible, even if the free period of the atmosphere were exactly 12 hours. The desired resonance, in fact, can only be obtained if the time taken for an inequality of temperature to be reduced by radiation or conduction in the ratio $e : 1$ is greater than 76 hours. The discrepancy between the calculated free period and 12 hours remains unexplained.

H. L. Wright, M.A.—The variation of soil temperature below turf: a discussion of observations at Kew Observatory. (*Memoirs, Vol.* 4, *No.* 31.)

The diurnal variation of soil temperature at depths of 10 cm.

and 20 cm. has been analysed. It is found that heat passes from 10 cm. to 20 cm. more rapidly by about one hour and a half than is consistent with the decrease in the ranges of temperature at these depths. The suggestion is advanced that the grass interferes with the normal course of heat conduction. The conduction of heat to a depth of 20 cm. in soil at Kew has been compared with that at Potsdam to an equal depth in a homogeneous stratum of sand. The range of temperature in sand is about twice as great as in loam, and the maximum temperature is reached one hour and a half earlier at Potsdam than at Kew. The diurnal variation of temperature at the " surface " has been deduced by extrapolation. At Potsdam the " surface " temperature becomes a maximum 50 minutes sooner than the air; at Kew the " surface " temperature is a maximum 40 minutes later than the air. It is suggested that the difference, one hour and a half, may represent the time taken to transmit the heat through the grass at Kew.

J. M. Sil (Meteorological Dept., Poona, India).—Variations in potential gradient caused by some meteorological phenomena.

The author has brought together a number of examples of abnormalities in potential gradient and has endeavoured to trace the connexion between them and some meteorological phenomena such as strong insolation, strong wind, the occurrence of a sea breeze, dust storm, &c. The abnormal effect caused by a duststorm was also produced experimentally on a calm day by blowing a small quantity of local dust particles at a point 3 ft. below the collector. The earth's position field in this instance was quickly reversed.

Correspondence

To the Editor, *The Meteorological Magazine.*

Obelisk shattered by Lightning

Through the courtesy of Lady Rosamond A. Christie, of Tapley Park, Instow, N. Devon, we are able to give some details relating to damage caused by a remarkable flash of lightning in a thunderstorm that developed in that neighbourhood in the early morning of June 11th, 1932. The storm was not in other respects a particularly severe one; it developed apparently just in front of the trough separating a cool NW. wind current out on the Atlantic from a belt of southerly winds that prevailed from the western Mediterranean to the seas to the east of Spitsbergen, a shallow cyclonic centre lying at the time west of the Scilly Isles. The flash is described as having been accompanied by a hissing sound. It struck and completely shattered, with an explosive crash, a massive granite obelisk over 50 ft. high standing in an isolated position, which has been a landmark

for shipping since it was erected in about 1854. Large blocks of granite were hurled about thirty yards in two directions, but, as will be seen in the photograph facing p. 135, four cannon at the corners of the base of the column were undisturbed.

Storms that just fail to come off

Very interesting are those days in summer when, though there is an obvious threat of showers or storms, these just miss developing except, perhaps, in a very few places because conditions are not quite favourable in the upper air.

Two marked cases occurred in London on June 22nd and 23rd, 1932. June 22nd was a glorious day of wonderful skyscapes, but the somewhat heavy cumulus clouds indicated a tendency for showers that would not mature, yet rain fell that day as near as Sussex and a whirlwind occurred in Hertfordshire.

The next day, June 23rd, went a little further in the direction of storms, though these were still not mentioned in the forecasts. About 6.30 p.m. I noticed intensely black sky over London from Hampstead, and remarked it was just "touch and go." As a matter of fact highly localised hailstorms were developing over Surrey at that time.

L. C. W. Bonacina.

35, Parliament Hill, Hampstead. June 25th, 1932.

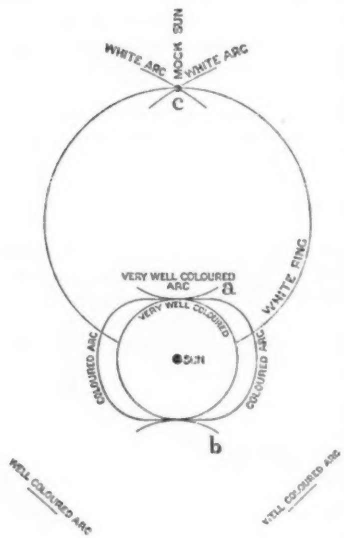
NOTES AND QUERIES

Halos of May 10th, 1932, at Padstow

A fine halo complex was recorded by two observers on the afternoon of May 10th. Commander H. E. Turner, H.M.S. *Beaufort*, off Padstow, sent the sketch reproduced in the accompanying figure. He remarks on the wonderful colours shown: "At the brightest places the colouring was as distinct and bright as a rainbow . . . and the spectrum could be seen from orange to blue or violet. The sky was slowly clouding over with cirrostratus from the south-westward, and was about 9/10 covered at the time, being only clear in the extreme north-eastward, where there was detached cumulus. . . . The barometer appeared to have reached the top of its upward curve (we were in a wedge of high pressure), and soon afterwards it began to fall." The phenomena were first seen at 14h. 40m. B.S.T., the diameter of the parhelic circle was measured about 15h. 40m., a few minutes before it began to disappear, when the altitude of the sun was approximately $45\frac{1}{2}°$.

Mr. W. M. Lindley, Trevone, Padstow, writes: "On Tuesday, May 10th, 1932, at about 14h. 40m. B.S.T., a solar halo was seen of the normal 22° radius type. This was accompanied by

a very strong tangent arc extending all round the halo. My impression was that the outer halo was in the form of an ellipse, with the major axis inclined at some 20° to the horizon and sloping down from south to west. As far as I can remember the maximum radii of the outer halo were in a straight line, though I have since learned that according to theory the halo is not a true ellipse and there should be symmetry about the vertical. I estimated the major axis of the 'ellipse' as $1\frac{1}{4}$ times the diameter of the inner halo.



The horizontal circle (white) was also seen in its entirety from outer halo through countersun to outer halo. No parhelia could be detected in spite of careful search, and only towards the end of the display was a small arc of the 46° halo seen in the west. The sky was almost cloudless and the complete phenomenon was seen until about 15h. 30m. B.S.T., when clouds formed.

The main point of interest was the tangent arc which was most distinct and almost as bright as the main halo, and persisted, easily visible, for the whole time. The horizontal circle cut the ellipse above the end of the major axis in the west. The segments between halo and ellipse were brighter than the inside of the halo, but I could not determine whether they were brighter or fainter than the outside sky. The shade was quite clearly different, but neither by colour nor by intensity could I make judgment. The colours of the tangent arc were those of the halo, but not as sharp (red towards sun).

I have worked out the altitude of the sun at 15h. B.S.T. and it comes out at about 51°."

There are a number of interesting points about this display. The two additional arcs of contact of the 22° halo, marked *a* and *b*, are quite special. The upper one *a* is Parry's upper arc. The lower one, *b*, is presumably the analogous lower arc which occurs in the St. Petersburg halo ("Dictionary of Applied Physics," Vol. III, p. 530). The oblique arcs, *c*, through the anthelion will also be noticed.

Alto-cumulus formed by an aeroplane

On three occasions recently we have experienced at South Farnborough, Hants, a repetition of the above phenomenon, similar to that described in the May, 1931 number of the *Meteorological Magazine*.

On April 21st, 1932, my attention was riveted on a short and very narrow band of white cloud at medium cloud height when F.-Lt. G. H. Stainforth telephoned to inform me that he had witnessed its formation a few minutes earlier. Further, he stated that he had himself formed a similar cloud on April 15th, 1932, and at the same time seen a streak of cloud emanating from another machine well above him. On the third occasion, May 7th, the formation was witnessed by many ground observers as well as by the pilot, who in this case had succeeded in repeating another pilot's unintentional demonstration.

The following brief accounts may be of interest. The first was given by F.-Lt. Stainforth. Unfortunately the pilot of the aeroplane on the second occasion was unaware of his connexion with cloud formation. He has, however, told me his rate of climb which, together with certain angular measurements of the cloud, have enabled me to determine roughly the figures quoted.

1. April 15th, 1932, between 14h. 50m. and 16h. G.M.T.

Cloud formed at 12,000 ft. (altimeter reading) and could be formed within a layer 1-2,000 ft. thick at least, from this height. Appeared as a single stream, which, when seen at close quarters, consisted of a spiral formation. The temperature was 5°F. at 11,480 ft., and 0°F. at 13,380 ft.

2. April 21st, 1932, between 16h. 4m. and 16h. 25m. G.M.T.

Cloud formed at 11,000 ft. within a layer 200-400 ft. thick commencing at this height. Apparently it first appeared as a single dense stream to the south-west of the zenith. When I saw it about four minutes later, then nearly overhead, it had a sharply defined wavy outline. This characteristic was not retained at the leeward end. It was drifting lengthwise with the wind from 230° at a speed of 35 m.p.h. and gradually spreading out fore and aft, developing a filigree pattern somewhat similar to that displayed by a medium height cloud approaching at that time from the south-west. It was finally intercepted by cumulus after being under observation for about twenty minutes, during which time it seemed to be slowly breaking in halves. The temperature was 18°F. at 10,000 ft. and 10°F. at 12,000 ft. (heights uncorrected).

3. May 7th, 1932, at 10h. 10m. G.M.T.

Cloud formed at 9,800 ft. (uncorrected) within a layer 100-200 ft. thick, commencing at 9,800 ft. The pilot had just passed through a thin cloud at about the same height. From the

ground two thin elegant streams were observed coming from the machine, resembling cirro-cumulus; after a few seconds they united and formed a billowy alto-cumulus ribbon. This became much wider as it drifted from 320° at a speed of 13 m.p.h., and gradually dispersed. Higher alto-cumulus was also dispersing. Cumulo-nimbus tops close to the region of formation were at about the same level. The pilot reported " no bumps." The temperature at 9,240 ft. was 5°F. and at 10,190 ft. 2·5°F.

F.-Lt. Stainforth's evidence of the phenomenon on April 15th brings to light the probable reason for its formation. He states: " First noticed white ' smoke ' against the background of struts; traced it distinctly to the propeller tips; looked back and could see the white trail." On this occasion at least, condensation appears to have originated at or near the propeller where a reduction of pressure is produced on the forward side.* It is at its maximum, I understand, at a point approximately two-thirds the length of the blades from the centre. Vapour may be condensed hereabouts and centrifugal force carry it to the tips, there to be thrown off and carried away in the slip-stream.

If the twin streams, observed temporarily on January 14th, 1931, and again on May 7th, 1932, originated in this way, perhaps the aeroplane's rudder unit was responsible for the division, although why it should occur on one type of machine and not another (all high-powered single-engined biplanes) is not understood. The cloud would be formed as a vortex presumably, and the thickest section seen from below, when the cloud is horizontal, would be along its outer boundary. The middle section is comparatively thin, but one would not expect it to be invisible.

The occasion when F.-Lt. Stainforth saw a machine make a pattern above him—a thin streak like a C, which persisted for at least half an hour—at an altitude of 18,000-25,000 ft., seems to be an ordinary exhaust cloud. The critical temperature for its formation is in the neighbourhood of −40°F. The temperature recorded at South Farnborough during the afternoon of the day in question was −33°F. at 21,220 ft. and −45°F. at 24,820 ft.†

It is not, perhaps, without significance that the air mass on all occasions (with the possible exception of April 15th) has been maritime polar. The weather, apart from January 14th, 1931, has been of the " cool showery " type. The barometric distribution has been similar on all occasions with a low-pressure system over Europe and high pressure to the west.

J. S. SMITH.

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*See *Meteorological Magazine*, 66, 1931, p. 90 (1) (*b*).

†See *Meteorological Magazine*, 61, 1926, p. 116.

Italian upper air investigations

Valuable additions to our knowledge of upper air conditions are being made by the Ufficio Presagi, Rome. Since January, 1930, surface and aerological observations have been made regularly by a station at Cape Guardafui and transmitted by wireless to shipping. Pilot balloon ascents are being made also on board Italian merchant ships between Italy and South America, and meteorograph records are obtained by means of an aeroplane at Montecelio. All these results are discussed in volume IV of the *Annali Ufficio Presagi,* which also contains a study by F. Castriota of "Baric fluctuations and symmetric points for the winter 1930-1931" over the Atlantic Ocean.

Reviews

Grundriss der Klimakunde. By Prof. Dr. W. Köppen. 2nd revised edition of Die Klimate der Erde. Size $8\frac{1}{2} \times 5\frac{1}{2}$ in., pp. xii. +388, *Illus.* Berlin and Leipzig, 1931.

Köppen's scheme for the classification of climates, as set out in "Die Klimate der Erde," has proved to be a very convenient shorthand for the rapid description of climates and for the plotting of climatic provinces on charts. It has been employed for the latter purpose in a number of detailed climatological studies and practical use has suggested some minor improvements which are embodied in a new edition. Further, some new sections have been added to make the book more complete as a text-book of climatology, a function which is indicated by the change of title.

The general scheme of the classification is briefly as follows: The world is first divided according to the distribution of temperature and rainfall into a series of major zones or provinces; A, a tropical zone of uniformly high temperature; B, two subtropical arid zones; C, two warm-temperate zones; D, a cold temperate or "boreal" province which is found only in the northern hemisphere; E, zones of cold climate or tundras beyond the limit of tree-growth, and F, the climate of eternal frost (warmest month below freezing point) found only in Greenland and Antarctica. These major zones are then sub-divided according to the type of climate within the zone, each peculiarity being given a characteristic letter, such as *w*, winter dry season, *n*, frequent fog (Nebel), *S*, steppe climate, *W*, desert (Wüst). Most of these characteristics are defined numerically, so that the main features of the climate of any region can be set down with the brevity and something of the exactness of a chemical formula.

The most important change from the first edition is in the definitions of steppe and desert climates. These depend on the balance of rainfall and evaporation, and the most convenient measure of the latter is the mean temperature of the year, or of

the season in which the greater part of the rain falls, but the form of the expression has been altered slightly and the criteria of desert and steppe are made far more rigorous, especially in a cold climate. They may even be too rigorous, for a region with a mean annual temperature of 50°F. and a rainfall of just over 4 inches a year falling mainly in the winter months is now regarded as steppe and not as desert. R. J. Russell,* investigating the application of Köppen's formulæ to the dry regions of the United States, apparently considers that the best criterion of desert would be somewhere between the old and new formulæ, a conclusion with which the reviewer is disposed to agree.

Another important change in the new edition is shown in the frontispiece map, which is now printed in colours and is on Mercator's projection instead of Mollweide's. The appearance of the map is greatly improved, and the colours facilitate easy reference, but a large amount of detail has been sacrificed by omitting the climatic formulæ which were a most useful feature of the earlier map. Thus a great belt from central Europe and Scandinavia to central Siberia now appears in a uniform tint denoting a " moist-winter cold climate "; formerly this large region was sub-divided into sections with five or more months above 10°C. and with less than five months above 10°C., an important distinction for agricultural purposes. Again, in the new chart the region of the southern Sahara, for example, appears simply as " Steppe," but in the old chart as B S h w t, which means a hot steppe climate with the dry season in winter and the highest temperatures in the autumn—a far more encyclopædic description.

The tables, which are in a very condensed form and yet occupy 70 pages, are a feature of very great value, containing the essential climatic data for more than one thousand stations. An index has been added for the purposes of reference, and the whole work forms an excellently compact summary of existing knowledge of the earth's climate.

Our Natural Water Supply. By J. D. Schonken, B.A. Size $7\frac{1}{4} \times 5$, pp. 38, and *Plant life and the siccation process.* By J. D. Schonken, B.Sc., M.D., S. Afric., J. Sci., 28, 1931, pp. 238-45.

The influence of a forest covering on climate and run-off is a vital question in South Africa, and Dr. Schonken throws himself whole-heartedly into the discussion. He classifies countries according to their " climatic status," which is their natural relative humidity derived from extraneous sources. Where the relative humidity is naturally high, as in Great Britain, deforestation has no appreciable effect on the climate, but where

*Dry climates in the United States. Univ. California Publ. Geogr. 5, No. 1, Berkeley. 1931.

little moisture penetrates from surrounding oceans, as in South Africa, he regards the maintenance of a transpiring forest cover as essential. While he recognises that even in these countries deforestation has very little effect on the actual amount of rain which falls in a year, he considers that it has a markedly harmful effect in increasing the irregularity of the rain and also in drying out the air and the soil. Still greater is its effect in promoting the washing away of the soil and in converting clear perennial streams into muddy occasional torrents. Hence, South Africa must afforest on a large scale or face ruin. Although the first of these two papers, which is a translation of two lectures delivered at Stellenbosch University, is frankly polemical, it is very persuasive and makes powerful use of the facts of history.

India Meteorological Department, Scientific Notes. Vol. III, No. 26. *Some statistical relations of temperature and pressure in the upper atmosphere over Agra* (1926-29) *and Batavia* (1910-15). By S. Gopal Ras, B.A.; and Vol. III, *No.* 28: *Horizontal gradients of pressure and temperature in the upper atmosphere over India calculated from pilot balloon ascents.* By A. Narayanan, M.A.

Both these papers are valuable contributions to our knowledge of the atmosphere over India. The first gives standard deviations and correlation coefficients between pressure and temperature at fixed heights, and the second gives horizontal gradients of pressure and temperature, deduced by well-known methods from the variation of wind with height, on the assumption of "geostrophic" motion. In the winter half-year there are westerly upper winds, increasing upwards, and hence the temperature decreases to northwards. The computed gradient is steep between 4 and 9 Km. over northern India, as much as 1°C. per 100 Km. at Simla, while at Bangalore, in southern India, it is only 0.2°C. per 100 Km. Over Agra at this season the correlation coefficient between pressure and temperature is large from 2 to 8 Km., and remains positive up to 12 Km. The standard deviation of pressure is considerably lower at all heights than it is in England in all seasons, and the figures for temperature are also lower, except from 8 to 10 Km., where they are roughly similar.

In summer the conditions are different, and during the monsoon from June to September the temperature on the whole falls towards the south. Below 5 Km. and above 10 Km. the highest temperature is somewhere north of Simla, while between 5 and 10 Km. it is between Agra and Poona. Sounding balloons have shown that in July and August the upper air temperature is higher over Agra than over Batavia, owing to the heat set free by condensation in the monsoon. The correlation coefficient between temperature and pressure is negligible during the mon-

soon up to 4 Km., and is only high between 9 and 14 Km. The standard deviation of temperature above 2 Km. has only about half its winter value. Over Batavia the relationships are on the whole similar to those over India during the monsoon, which are thus essentially of tropical type.

The correlation coefficient between the pressure at the surface and at 9 Km. at Agra is − 0.67 for the whole year, owing to seasonal influence, but is negligible for the winter and monsoon seasons considered separately.

C. K. M. DOUGLAS.

India Meteorological Department, Scientific Notes. Vol. IV, No. 42. *A discussion of monthly mean values of upper air temperatures and humidities obtained from aeroplane ascents at Peshawar and Quetta.* By A. Narayanan, M.A., Calcutta, 1931.

This paper is an analysis of the results of observation of pressure and temperature made from R.A.F. aeroplanes. It is based on some 700 flights made at or near Peshawar during the three years 1927-9, and some 500 flights made from Quetta during the three years ending May, 1930. In both cases all the flights used were made in the morning.

The paper describes the method of observation in some detail, and it is evident that considerable care was taken to insure the accuracy of the data obtained. The latter is presented in the form of numerous tables and graphs, and provides a mass of information useful for future reference. The region of the atmosphere covered is from the surface up to 4.5 Km. at Peshawar and up to 4 Km. at Quetta.

On one point more information would have been welcome. The tables of relative humidity include cases in which the mean temperature was considerably below freezing, in one case the mean was as low as 6°F. There is, however, no indication of how the relative humidity was measured under such circumstances; the equipment described (dry and wet strut thermometers) is quite inadequate for measuring relative humidity at such low temperatures.

The Indian Meteorological Department are to be congratulated on the steady additions which they are making to our knowledge of the upper atmosphere over India.

L. H. G. DINES.

Annales de l'Observatoire National d'Athènes. Published by D. Eginitis. Tome XI, Athens, 1931.

In accordance with the usual practice, this volume contains, besides summaries of astronomical and meteorological observations, a number of papers on geophysical and meteorological subjects. Professor Eginitis, Director of the Observatory,

contributes an extensive study of the peculiar tidal phenomena in the Strait of Euripus which have presented a problem to various investigators from Aristotle onwards.

In "Sur les causes des mouvements microsismiques réguliers du sol d'une periode de 4s.—8s. à Athènes," N. A. Critikos attributes these particular microseisms to the action of the prevailing northerly winds on the land masses.

The meteorological papers include a note on the climate of Zante by A. N. Livathinos, and a study of evaporation at Athens by Th. Findiklis. In the last-mentioned paper is discussed a homogeneous set of observations with a Piché evaporimeter from 1894 to 1928. The normal depth of water evaporated annually at Athens according to these observations is 1,600 mm. (64 inches).

The astronomical and meteorological summaries cover the period 1927-9.

S. T. A. Mirrlees.

Average number of rain-days in Java and Madoera during the four consecutive for every station driest months of the year. By Prof. Dr. J. Boerema. Kon. Magn. Meteor. Obs. Batavia. Verh. No. 23. Size $10\frac{1}{2} \times 7\frac{1}{4}$in., pp. 25 + map. English summary, Batavia, 1931.

The publication gives statistics of the mean number of rain-days during the four driest consecutive months of the year, at some 2,500 stations in Java and Madoera. A map is also given on a scale of 1 to 1,200,000 (19 miles to 1in.).

Maps of the mean annual and monthly rainfall and of the positions of the various stations have already been given in Verh. No. 14, while the distribution of the average monthly rainfall throughout the year was given in Verh. No. 18. In the review of the latter publication* details were given of the causes of the dry and wet seasons.

In practically the whole of this area the driest four months occur with the south-east monsoon, which travels for a much shorter distance over the sea than does the north-west monsoon. The number of rain-days in the driest four mouths decreases generally from west to east and from south to north. The number varies from just over 80, in the mountainous regions to the south of Batavia, to rather less than 5 along coastal strips in the extreme north-east of Madoera and Java. The decrease to the east is connected with the increasing dryness of the south-east monsoon towards Australia. The most striking droughts occur when the south-east monsoon crosses a mountain-ridge and descends into the plain as a föhn-like wind.

J. Glasspoole.

**Meteorological Magazine*, 62, 1927. p. 194.

Books Received

Bulletin de l'Observatoire de Talence (Gironde). 2nd Series, Nos. 15-18, Talence, 1931.

Royal Alfred Observatory, Mauritius. Results of magnetical and meteorological observations for September to December, 1930, and January to June, 1931; Port Louis, 1930 and 1931.

The Structure of the Sea-Breeze at Poona, by K. R. Ramanathan, M.A., D.Sc. India Meteor. Dept., Sci. Notes, Vol. III, No. 30.

The Lunar Atmospheric Tide at Kodaikanal and Periyakulam, by S. K. Pramanik, M.Sc., S. C. Chatterjee, B.Sc., and P. P. Joshi, B.Sc. India Meteor. Dept., Sci. Notes, Vol. IV, No. 31.

Obituary

Robert Bessel Sargeant.—We regret to learn of the death of Mr. R. B. Sargeant at his home in Lancing on June 25th. Mr. Sargeant was born on May 28th, 1856, and entered the Meteorological Office in November, 1871, at the age of fifteen, being attached to the "Telegraph" department, as the forecasting service was then termed. He was associated with this division during the greater part of his career, and in 1901 he became one of the officers in charge of the issue of forecasts and gale warnings. During the war, when forecasting duties became very arduous and responsible, while the cessation of many reports added to the difficulties, Mr. Sargeant was our most experienced forecaster, and those who had to learn their work under war conditions owe much to his kindly help. He met the most difficult or critical situations with an unhesitating confidence which was a splendid example to his younger colleagues. His knowledge of past weather situations, when he could be brought to display it—for he was the most unassuming of men—was amazing. In 1920 he became Assistant Superintendent in the Forecasting Division, and helped to train the post-war generation of forecasters. He retired on March 1st, 1922, after more than fifty years of continuous service.

William Gardner Reed.—We regret to learn of the death of Mr. W. G. Reed on March 30th, 1932. Mr. Reed studied meteorology at Harvard, where he was awarded the A.M. degree for a study of the cyclonic distribution of rainfall in the United States, which was published in the *Monthly Weather Review* in 1911. From Harvard he went to the University of California as instructor in meteorology, but after a few years he joined the climatic section of the Atlas of American Agriculture under the U.S. Department of Agriculture, where he became specially interested in the frost hazard in farming. His papers on this subject were much appreciated, and after the frost folio of the

Atlas was completed, he transferred to the Weather Bureau and specialised in fruit frost forecasting in Utah.

We regret to learn of the death, on December 21st, 1931, in his ninety-first year, of Dr. Daniel Draper, for more than 42 years official meteorologist for the City of New York.

News in Brief

Mr. H. Jameson, M.Sc., F.Inst.P., has been appointed Director of Colombo Observatory, Ceylon, in succession to Mr. A. J. Bamford, who has retired.

Professor Dr. H. Hergesell retired on April 1st from the Directorship of Lindenberg Aeronautical Observatory, which he has held since May 1st, 1914.

We learn from *Nature* that a scientific institute has recently been established in Moscow to carry on research on the circumstances of formation of cloud, fog and rainfall. The institute has branches in Leningrad, Odessa, Saratov, Tashkent and Askhabad.

The Weather of June, 1932

Except for parts of Sweden pressure was above normal in a belt extending from Russia across the British Isles and North Atlantic to north-west Canada and from Russia across south-east Europe and Italy to north Africa and south Spain and also over Bermuda and California; the excess reached 5·7mb. at Julianehaab. Pressure was below normal over France, Switzerland, north Spain and across the Azores and Nova Scotia to the United States and west and south-east Canada. Temperature was generally below normal except at Spitsbergen where it was above normal. Rainfall was deficient except in Spitsbergen and parts of Sweden; in the coastal districts of northern Norrland it was 90 per cent. above normal, but in Scania it was only one-third of the normal.

Over the British Isles, June, 1932, in contrast to May, was unusually dry up to the 27th, and in some parts sunny. There were absolute droughts of 29 days at Cheltenham from May 30 to June 27, and of 28 days at Harrogate and Dunbar from May 30 to June 26 and May 29 to June 25 respectively. At the beginning of the month an area of high pressure over Greenland and Iceland extended over the northern part of the British Isles; the 2nd was generally sunny and high day temperatures were recorded in western Scotland, but the eastern districts were cooler. A depression on the Atlantic moving south-east caused heavy rain locally on the 3rd on the south

coast and Channel Isles. On the 4th polar air coming down the North Sea caused cool weather; maximum day temperatures were low in many places, notably 50° at Lympne and 51° at Plymouth and Leafield. The anticyclone over Iceland then moved southward and finally eastward, and temperature gradually rose; good sunshine records were obtained on the 9th and 11th, and high day temperatures were recorded on the 11th in eastern England. From the 10th to 11th a shallow trough of low pressure crossed the British Isles and thunderstorms occurred locally on the 11th. On the 12th an anticyclone south-west of Iceland moved eastwards over the British Isles, and later the Azores anticyclone extended north-east and a spell of dry sunny weather occurred generally, though there was some rain with thunder in Ireland. Day temperatures were high in western Scotland, 80° being reached at Renfrew on the 17th. About the 19th a depression spread eastwards from the Baltic causing an incursion of cool air from the North Sea, day temperatures were low on the 19th and 20th but little rain fell, and there was good sunshine in parts of the west and south. From the 21st most of the British Isles came under the influence of an anticyclone to the south-west of Ireland and temperatures rose; depressions, however, crossing Iceland rendered the weather in northern districts somewhat unsettled. The fair spell broke in England on the 27th, when a secondary trough to a deep depression near the Faroes moved across the country; heavy rain and thunderstorms occurred locally on the 27th and 28th. In front of a depression west of Ireland, heavy rain fell in the south-west on the 29th and spread to all districts on the 30th. Many stations recorded more than an inch of rain on the 30th and some stations more than 3 inches—notably Holne, Devon, 3·28 in.; S. Brent, Devon, 3·70 in.; St. Briavels, Glos., 3·20 in.; Llyn Fawr, Glamorgan, 3·16 in.; and Treherbert, Glamorgan, 3·15 in. The distribution of bright sunshine for the month was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	166	—12	Liverpool	212	+12
Aberdeen	175	— 9	Ross-on-Wye	227	+30
Dublin	209	+20	Falmouth	266	+45
Birr Castle	188	+24	Gorleston	183	—27
Valentia	187	— 1	Kew	211	+14

The special message from Brazil states that the rainfall was irregular with 0·16in. above normal in the northern regions, 0·08in. above normal in the central regions and 0·51in. below normal in the southern regions. Crops generally in good condition except in Sao Paulo and Minas the coffee crop was suffering from excessive rains. Four anticyclones passed across the country. At Rio de Janeiro pressure was 1·2mb. below normal and temperature 0·4°F. above normal.

Miscellaneous notes on weather abroad culled from various sources. Eighty people were killed and 80 injured in a hurricane which struck the town of Ismail, Roumania on the 2nd. In consequence of the heavy rains extensive floods occurred in Swedish Lapland at the beginning of the month. A hailstorm swept across the Jura region on the night of the 2nd and destroyed vineyards along Lake Neuchatel; the following day there was a cloud-burst over Oppenheim on the Rhine, which wrought havoc with the vineyards of that district. Snow fell in Bologna and Tuscany on the 24th, and hail along the Italian Riviera, while storms were experienced in Venice and Trieste. Torrential rain and hail fell in Moldavia and Bukovina on the 25th and 26th, followed by floods; some 30 people were drowned. Towards the end of the month violent storms in the mountainous regions of Portugal destroyed many crops and vineyards, and snow fell in the Bavarian Allgäu in south Germany as low as 4,500 ft. above sea level, which is very unusual in June. (*The Times*, June 3rd-29th.)

About the 8th, the monsoon was said to be reviving in the south-east of the Arabian Sea; it reached Bombay on the night of the 19th, when nearly 4 in. of rain fell. A storm of great severity passed over Jubbulpore on the 11th, killing 3 people. Deaths from heat were reported from many parts of northern India during the month. The monsoon arrived late in Burma and the rainfall was small. The Arabian Sea monsoon was active over the Central and United Provinces during the latter part of the month. (*The Times*, June 9th-24th.)

At the beginning of the month widespread rains, up to 1½ in., fell west of a line from Cloncurry to Brisbane, and also general rains over the agricultural areas of Western Australia. Soaking rains occurred over the whole agricultural area of South Australia during the 11th-12th. (*The Times*, June 7th-14th.)

Unprecedented cold with gales, fog and snow occurred off Newfoundland early in the month. Weather conditionns were good for the crops generally in Canada during the month. In the United States the temperature was variable and the rainfall deficient generally at first, but later in excess except in the Lake Region, Mountain Region, and the Pacific Coast. Good rains fell in parts of Buenos Aires, Cordoba and Sante Fé about the middle of the month. Bad weather prevailed in Montevideo about the 25th and the port was closed. (*The Times*, June 4th-29th, and *Washington, D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin.*)

Rainfall, June, 1932—General Distribution

England and Wales	59	per cent of the average 1881-1915.
Scotland	49	
Ireland	60	
British Isles	57	

Rainfall: June, 1932: England and Wales.

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Lond .	Camden Square	·70	35	*Leics* .	Belvoir Castle............	1·48	78
Sur .	Reigate, Alvington ...	1·68	81	*Rut* .	Ridlington	·46	24
Kent .	Tenterden, Ashenden...	1·39	73	*Lincs* .	Boston, Skirbeck	·40	22
,, .	Folkestone, Boro. San .	1·48	...	,,	Cranwell Aerodrome ...	·41	24
,, .	Margate, Cliftonville...	·53	30	,, .	Skegness, Marine Gdns	·65	36
,, .	Sevenoaks, Speldhurst	1·26	...	,, .	Louth, Westgate	·38	18
Sus .	Patching Farm	1·72	85	,, .	Brigg, Wrawby St. ...	·57	...
,, .	Brighton, Old Steyne..	1·30	72	*Notts* .	Worksop, Hodsock ...	·66	33
,, .	Heathfield, Barklye ...	1·72	82	*Derby* .	Derby, L. M. & S. Rly.	·94	42
Hants .	Ventnor, Roy. Nat. Hos.	2·16	118	,, .	Buxton, Devon Hos. ...	1·06	33
,, .	Fordingbridge, Oaklnds	2·25	122	*Ches* .	Runcorn, Weston Pt...	·35	14
,, .	Ovington Rectory	2·34	101	,, .	Nantwich, Dorfold Hall	·63	...
,, .	Sherborne St. John ...	1·55	73	*Lancs* .	Manchester, Whit Pk.	·35	13
Berks .	Wellington College ...	1·13	52	,, .	Stonyhurst College ...	·99	32
,, .	Newbury, Greenham...	1·59	73	,, .	Southport, Hesketh Pk	·68	31
Herts .	Welwyn Garden City...	·75	...	,, .	Lancaster, Strathspey	1·86	...
Bucks .	H. Wycombe, Flackwell	·80	...	*Yorks* .	Wath-upon-Dearne ...	·47	21
Oxf .	Oxford, Mag. College...	·52	24	,, .	Bradford, Lister Pk. ...	·57	24
Nor .	Pitsford, Sedgebrook...	·66	34	,, .	Oughtershaw Hall	2·93	...
,, .	Oundle.....................	·33	...	,, .	Wetherby, Ribston H.	·44	21
Beds .	Woburn, Crawley Mill	·67	34	,, .	Hull, Pearson Park ...	...	...
Cam .	Cambridge, Bot. Gdns.	...	...	,, .	Holme-on-Spalding ...	·49	...
Essex .	Chelmsford, County Lab	·59	31	,, .	West Witton, Ivy Ho.	1·75	86
,, .	Lexden Hill House ...	·47	...	,, .	Felixkirk, Mt. St. John	1·00	46
Suff .	Haughley House.........	·45	...	,, .	Pickering, Hungate ...	·62	29
,, .	Campsea Ashe............	·42	22	,, .	Scarborough	·43	23
Norf .	Norwich, Eaton.........	...	...	,, .	Middlesbrough	·94	50
,, .	Wells, Holkham Hall	·39	20	,, .	Balderdale, Hury Res.	1·15	...
,, .	Swaffham, The Villa...	·68	31	*Durh* .	Ushaw College	1·08	50
Wilts .	Devizes, Highclere......	1·19	53	*Nor* .	Newcastle, Town Moor	·72	33
,, .	Bishops Cannings	1·34	55	,, .	Bellingham, Highgreen	1·34	58
Dor .	Evershot, Melbury Ho.	3·29	144	,, .	Lilburn Tower Gdns...	1·84	89
,, .	Creech Grange	2·67	116	*Cumb* .	Geltsdale..................	1·26	...
,, .	Shaftesbury, Abbey Ho.	·70	30	,, .	Carlisle, Scaleby Hall	·95	38
Devon .	Plymouth, The Hoe...	3·56	165	,, .	Borrowdale, Seathwaite	5·25	86
,, .	Launceston, Werringt'n	3·09	...	,, .	Borrowdale, Moraine...	4·67	...
,, .	Holne, Church Pk. Cott.	5·32	185	,, .	Keswick, High Hill...	2·25	...
,, .	Cullompton...............	1·73	82	*West* .	Appleby, Castle Bank	2·25	98
,, .	Sidmouth, Sidmount...	2·80	133	*Glam* .	Cardiff, Ely P. Stn. ...	1·55	62
,, .	Filleigh, Castle Hill ...	1·25	...	,, .	Treherbert, Tynywaun	3·94	...
,, .	Barnstaple, N. Dev. Ath	·85	38	*Carm* .	Carmarthen Friary ...	2·87	100
,, .	Dartm'r, Cranmere Pool	4·60	...	*Pemb* .	Haverfordwest, School	2·45	91
Corn .	Redruth, Trewirgie ...	3·48	140	*Card* .	Aberystwyth	1·18	...
,, .	Penzance, Morrab Gdn.	3·01	136	,, .	Cardigan, County Sch.	1·73	...
,, .	St. Austell, Trevarna...	2·87	110	*Brec* .	Crickhowell, Talymaes	2·00	...
Soms .	Chewton Mendip	1·79	60	*Rad* .	Birm W.W. Tyrmynydd	1·99	61
,, .	Long Ashton	1·42	56	*Mont* .	Lake Vyrnwy............	1·68	53
,, .	Street, Millfield.........	1·09	51	*Denb* .	Llangynhafal	·76	36
Glos .	Blockley	1·37	...	*Mer* .	Dolgelly, Bryntirion...	2·03	58
,, .	Cirencester, Gwynfa ...	1·26	53	*Carn* .	Llandudno	·96	47
Here .	Ross, Birchlea............	1·68	77	,, .	Snowdon, L. Llydaw 9	5·40	...
,, .	Ledbury, Underdown..	1·31	58	*Ang* .	Holyhead, Salt Island	1·40	65
Salop .	Church Stretton.........	1·16	48	,, .	Lligwy.....................	1·21	...
,, .	Shifnal, Hatton Grange	·72	32	*Isle of Man*			
Worc .	Ombersley, Holt Lock	·82	36		Douglas, Boro' Cem. ...	2·19	89
War .	Birminghm, Edgbaston	1·66	72	*Guernsey*			
Leics .	Thornton Reservoir ...	1·26	58		St. Peter P't. Grange Rd.	1·33	72

Rainfall: June, 1932: Scotland and Ireland.

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Wigt .	Pt. William, Monreith	1·25	53	*Suth* .	Melvich	·49	...
,, .	New Luce School......	1·72	60	,, .	Loch More, Achfary...	1·73	47
Kirk .	Carsphairn, Shiel	2·71	68	*Caith* .	Wick	·65	36
Dumf .	Dumfries, Crichton, R.I	1·93	...	*Ork* .	Pomona, Deerness......	1·00	54
,, .	Eskdalemuir Obs.	1·38	44	*Shet* .	Lerwick	1·50	84
Roxb .	Branxholm	1·49	66	*Cork* .	Caheragh Rectory	1·56	...
Selk .	Ettrick Manse............	1·47	41	,, .	Dunmanway Rectory .	2·46	70
Peeb .	West Linton	1·20	...	,, .	Ballinacurra	1·62	62
Berw .	Marchmont House......	1·42	61	,, .	Glanmire, Lota Lo......	1·68	62
E. Lot .	North Berwick Res....	1·08	65	*Kerry* .	Valentia Obsy............	2·95	92
Midl .	Edinburgh, Roy. Obs.	1·00	50	,, .	Gearahameen	3·50	...
Lan .	Auchtyfardle	2·00	...	,, .	Killarney Asylum	2·60	89
Ayr .	Kilmarnock, Kay Pk. .	1·42	...	,, .	Darrynane Abbey	2·55	81
,, .	Girvan, Pinmore.........	1·99	69	*Wat* .	Waterford, Gortmore...	2·14	82
Renf .	Glasgow, Queen's Pk. .	·98	42	*Tip* .	Nenagh, Cas. Lough ..	1·49	61
,, .	Greenock, Prospect H.	1·76	53	,, .	Roscrea, Timoney Park	1·31	...
Bute .	Rothesay, Ardencraig.	1·83	60	,, .	Cashel, Ballinamona ...	1·04	45
,, .	Dougarie Lodge.........	1·64	...	*Lim* .	Foynes, Coolnanes......	1·57	61
Arg .	Ardgour House	2·10	...	,, .	Castleconnel Rec......	·64	...
,, .	Glen Etive	1·88	40	*Clare* .	Inagh, Mount Callan...	2·35	...
,, .	Oban	1·08	36	,, .	Broadford, Hurdlest'n.	1·14	...
,, .	Poltalloch	2·11	70	*Wexf* .	Gorey, Courtown Ho...	1·36	56
,, .	Inveraray Castle	1·71	43	*Kilk* .	Kilkenny Castle.........	1·63	67
,, .	Islay, Eallabus	1·88	72	*Wick* .	Rathnew, Clonmannon	1·29	...
,, .	Mull, Benmore	6·40	...	*Carl* .	Hacketstown Rectory..	1·53	55
,, .	Tiree	1·90	...	*Leix* .	Blandsfort House	1·48	57
Kinr .	Loch Leven Sluice......	1·60	73	,, .	Mountmellick............	·99	...
Perth .	Loch Dhu	2·60	62	*Offaly.*	Birr Castle	·56	24
,, .	Balquhidder, Stronvar	1·85	...	*Kild'r.*	Monasterevin	...	...
,, .	Crieff, Strathearn Hyd.	1·15	44	*Dublin*	Dublin, FitzWm. Sq....	·36	18
,, .	Blair Castle Gardens...	·73	37	,, .	Balbriggan, Ardgillan.	1·17	58
Angus.	Kettins School	·93	50	*Meath.*	Beaupare, St. Cloud ...	1·04	...
,, .	Dundee, E. Necropolis	·95	53	,, .	Kells, Headfort.........	1·20	45
,, .	Pearsie House............	1·20	...	*W. M* .	Moate, Coolatore	1·20	...
,, .	Montrose, Sunnyside...	.99	60	,, .	Mullingar, Belvedere...	1·05	40
Aber .	Braemar. Bank	1·17	60	*Long* .	Castle Forbes Gdns....	·67	26
,, .	Logie Coldstone Sch....	·63	32	*Gal* .	Ballynahinch Castle...	2·71	77
,, .	Aberdeen, King's Coll.	1·13	66	,, .	Galway, Grammar Sch.	2·52	...
,, .	Fyvie Castle	·93	44	*Mayo* .	Mallaranny...............	4·07	...
Moray	Gordon Castle............	·29	14	,, .	Westport House.........	2·70	100
,, .	Grantown-on-Spey......	...	...	,, .	Delphi Lodge............	5·46	95
Nairn.	Nairn	·10	6	*Sligo* .	Markree Obsy............	2·32	79
Inv's .	Ben Alder Lodge......	·77	...	*Cavan.*	Belturbet, Cloverhill...	·80	33
,, .	Kingussie, The Birches	·55	...	*Ferm* .	Enniskillen, Portora...	1·42	...
,, .	Loch Quoich, Loan......	2·05	...	*Arm* .	Armagh Obsy............	·85	34
,, .	Glenquoich	2·55	52	*Down* .	Fofanny Reservoir......	5·80	...
,, .	Inverness, Culduthel R.	·22	...	,, .	Seaforde	1·77	64
,, .	Arisaig. Faire-na-Squir	1·39	...	,, .	Donaghadee, C. Stn....	1·29	55
,, .	Fort William, Glasdrum	·92	...	,, .	Banbridge, Milltown...	1·33	...
,, .	Skye, Dunvegan.........	2·96	...	*Antr* .	Belfast, Cavehill Rd....	1·59	...
,, .	Barra, Skallary	1·86	...	,, .	Glenarm Castle	2·50	...
R & C .	Alness, Ardross Castle	·55	24	,, .	Ballymena, Harryville	2·32	80
,, .	Ullapool	·74	31	*Lon* .	Londonderry, Creggan	1·36	48
,, .	Achnashellach	1·92	...	*Tyr* .	Omagh, Edenfel.........	1·67	59
,, .	Stornoway	1·56	...	*Don* .	Malin Head...............	1·10	...
Suth .	Lairg	·26	13	,, .	Dunfanaghy	1·13	...
,, .	Tongue	·63	31	,, .	Killybegs, Rockmount.	1·71	45

Climatological Table for the British Empire, January, 1932

STATIONS	PRESSURE Mean of Day M.S.L. mb.	PRESSURE Diff. from Normal mb.	TEMPERATURE Absolute Max. °F.	TEMPERATURE Absolute Min. °F.	Mean Values Max. °F.	Mean Values Min. °F.	Mean Values ½ max. and min. °F.	Mean Values Diff. from Normal °F	Mean Wet Bulb °F.	Relative Humidity %	Mean Cloud Am'nt 0—10	PRECIPITATION Am'nt in.	PRECIPITATION Diff. from Normal in.	PRECIPITATION Days	BRIGHT SUNSHINE Hours per day	BRIGHT SUNSHINE Percentage of possible
London, Kew Obsy.	1023·1	+ 5·5	56	22	48·4	38·8	43·6	+ 4·7	40·9	91	7·7	1·61	— 0·15	12	1·2	15
Gibraltar	1027·2	+ 6·0	68	38	61·3	49·7	55·5	+ 0·7	49·3	81	6·5	2·75	— 2·31	10	..	..
Malta	1025·3	+ 8·3	63	45	57·7	49·6	53·7	— 1·6	49·6	77	5·7	2·67	— 0·54	10	6·2	62
St. Helena	1013·5	+ 0·6	70	57	67·1	58·9	63·0	— 1·0	59·9	95	9·4	1·65	..	20	..	..
Sierra Leone	1012·6	+ 1·8	91	67	85·1	72·9	79·0	— 2·3	70·2	67	3·2	1·05	+ 0·64	1	..	..
Lagos, Nigeria	1010·5	+ 0·9	90	68	86·8	71·9	79·3	— 1·6	68·9	71	2·5	0·02	— 1·02	1	3·7	32
Kaduna, Nigeria	1013·6	— 1·1	96	55	87·2	57·8	72·5	— 0·9	54·0	30	1·3	0·00	0·00	0	8·4	73
Zomba, Nyasaland	1008·3	+ 0·9	90	57	81·8	64·1	72·9	+ 0·1	..	82	7·1	9·23	— 1·87	15	..	..
Salisbury, Rhodesia	1010·9	+ 0·2	86	51	79·7	60·0	69·9	+ 0·2	63·0	69	6·9	5·15	— 2·17	15	6·1	47
Cape Town	1015·5	+ 2·1	94	51	78·0	59·9	68·9	— 1·0	60·2	60	2·9	0·45	— 0·23	4	..	..
Johannesburg	1009·7	+ 0·2	88	44	78·5	55·7	67·1	+ 0·4	57·4	61	4.2	3·67	— 2·50	11	9·8	72
Mauritius	1012·0	+ 0·1	88	69	85·5	73·4	79·4	+ 0·1	75·7	73	6·8	7·63	— 0·13	22	7·5	57
Calcutta, Alipore Obsy.	1017·0	+ 1·8	86	51	80·9	58·9	69·9	+ 3·3	60·1	91	1·5	0·00	— 0·42	0*	..	..
Bombay	1015·0	+ 1·4	93	67	88·2	69·2	78·7	+ 3·2	67·6	77	1·4	0·00	— 0·10	0*	..	..
Madras	1016·1	+ 2·0	85	64	83·4	67·6	75·5	— 0·7	69·3	81	3·5	0·00	— 1·14	0*	..	..
Colombo, Ceylon	1012·3	+ 1·5	94	69	89·0	71·7	80·3	+ 0·8	72·6	70	2·4	0·00	— 3·25	0	8·8	75
Singapore	..	..	90	69	84·9	71·9	78·4	— 1·3	74·2	79	7·0	6·52	— 3·37	15	5·7	47
Hongkong	1022·9	+ 3·2	74	43	65·7	56·0	60·9	+ 0·7	54·2	64	3·9	0·00	— 1·32	0	7·1	65
Sandakan	..	..	86	71	84·8	74·5	79·7	— 0·1	75·9	83	..	11·22	— 8·18	20	..	..
Sydney, N.S.W.	1011·6	— 0·8	106	57	79·1	66·2	72·7	+ 1·1	67·3	71	8·1	0·25	— 3·42	2	6·6	47
Melbourne	1012·1	— 0·8	109	51	81·4	57·0	69·2	+ 1·8	59·2	52	4·7	0·01	— 1·88	1	7·3	50
Adelaide	1012·2	— 0·8	110	53	91·8	64·3	78·1	+ 4·2	61·9	31	3·9	0·15	— 0·57	1	10·5	74
Perth, W. Australia	1018·1	+ 5·6	106	58	88·4	67·5	77·9	+ 4·1	67·3	56	3·9	0·19	— 0·15	5	10.3	74
Coolgardie	1009·6	— 1·9	112	57	95·7	66·6	81·1	+ 3·7	63·6	42	3·9	0·39	— 0·07	4	..	..
Brisbane	1012·4	+ 1·1	99	64	86·9	69·0	77·9	+ 0·7	70·8	59	5·4	3·06	— 3·44	3	10·3	76
Hobart, Tasmania	1006·9	— 3·4	93	45	72·1	53·2	62·7	+ 0·7	52·8	46	6·0	0·28	— 1·55	7	8·8	59
Wellington, N.Z.	1008·6	— 4·7	71	41	64·7	52·0	58·3	— 4·2	54·8	71	7·0	2·16	— 1·17	11	7·6	51
Suva, Fiji	1006·6	— 0·9	91	69	85·4	74·5	79·9	0·0	75·3	80	7·6	11·66	+ 0·23	24	5·2	40
Apia, Samoa	1007·2	— 0·7	89	73	84·6	75·1	79·9	+ 0·9	77·2	82	7·4	21·34	+ 4·29	19	5·1	40
Kingston, Jamaica	1014·7	— 0·4	90	64	86·2	67·9	77·1	+ 0·3	66·0	84	3·0	0·41	— 0·55	4	8·8	79
Grenada, W.I.	1013·3	+ 0·5	90	70	87·0	72·9	79·9	+ 2·8	74·5	78	6·3	10·39	+ 6·01	27	..	..
Toronto	1018·2	+ 0·3	56	13	39·9	30·6	35·3	+13·1	32·3	82	8·2	5·32	+ 2·53	12	1·5	16
Winnipeg	1017·6	— 3·3	35	—29	14·4	—1·9	6·3	+10·2	..	..	4·6	0·00	— 0·91	0	..	..
St. John, N.B.	1018·4	+ 2·9	55	0	35·4	19·9	27·7	+ 8·5	23·5	78	7·0	4·54	— 0·26	9	3·3	36
Victoria, B.C.	1018·4	+ 2.4	50	16	41·3	34·7	38·0	— 1·0	35·4	87	7·7	4·23	— 0·31	19	2.5	26

*For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

Winnipeg	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
St. John, N.B.	1018·4	+ 2·9	55	0	35·4	19·9	27·7	+ 8·5	23·5	78	7·0	4·54	— 0·26	9	3·3	36
Victoria, B.C.	1018·4	+ 2.4	50	16	41·3	34·7	38·0	— 1·0	35·4	87	7·7	4·23	— 0·31	19	2.5	26